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Ultrasound and CT Evaluation of Pleural Lesions

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Abstract

Aims And Objectives: To assess the value of Ultrasonography and Computed Tomography in evaluation of pleural lesions. To determine the Sensitivity and Specificity of Ultrasound and CT in pleural lesions. **Summary:** The present study was aimed at assessing the value of Ultrasonography and CT in evaluating the pleural lesions. In our study, during the period of 12 months 100 patients with pleural effusions were evaluated. The most common cause was transudates. Exudates consist of malignant and non malignant causes.

Conclusion: The role of ultrasound and CT are complimentary, give high yield of positive results for pleural mass differentiation; useful for guided procedures, like pleural biopsy and pleural drainage. Combined study not only useful for localization of lesion but also gives information about the extent of disease and characterizing the tissue density by analysis of attenuation coefficient.

Keywords: *ultrasound, MDCT, pleural effusion, transudate and exudates.*

INTRODUCTION

The pleura is derived embryologically from the mesenchyme ⁽¹⁾. It serves an important role in lung function in that it acts as a cushion for the lungs and allows for smooth movement of the lungs within the chest cavity⁽²⁾.

A variety of imaging techniques can be used to evaluate the pleura and pleural space. Standard radiographs are the most commonly used, but difficult to differentiate the pleural collection from masses. Ultrasound is an effective, easily performed complimentary to chest radiograph in evaluation of puzzling areas of increased opacity

in the chest. Ultrasound may provide useful information that eliminates the need for more invasive/expensive studies. Useful in differentiating pulmonary consolidation from lung masses and pleural lesions, which are main causes of increased opacity on chest radiograph. Ultrasound provides detailed information about nature of pleural fluid. It allows determining whether a fluid is amenable to aspiration. Hence initial screening with ultrasound to determine whether the lesion is solid or fluid filled ⁽³⁾ helps to limit the differential diagnosis.

Chest CT scanning permits imaging of entire pleural space, pulmonary parenchyma and mediastinum simultaneously. CT reveals early stage of pleural abnormalities and contrast enhanced scan can depict multiple loculation and localizing effusion. Differentiate between lung consolidation Vs pleural effusion; cystic from solid lesion, necrotic areas, pleural thickening, nodules, masses or round atelectasis and peripheral lung abscess from lung empyema and tumoral extent. Helps in identifying benign Vs malignant involvement.

MATERIALS AND METHODS

The study was conducted in our hospital over a period of January 2015 to December 2015. It was a prospective study. A total of 100 patients with suspected pleural lesions on chest radiography were enrolled for this study. After obtaining relevant history and clinical data these cases were subjected to ultrasound (real time SS-D 1000 Aloka 5 MHz) and C.T (SEIMENS 16 SLICE). Subsequently the confirmed pleural lesions were subjected to pleurocentesis /FNAC/biopsy to know the nature of the lesion. A comparative study was done between USG and CT findings. Further, the pleural lesions were correlated with FNAC/biopsy⁽⁴⁾. These observations were analyzed and statistical assessments were performed.

Pleural Effusion

Collection of fluid between the visceral and parietal pleura. Pleural effusion is classically divided into transudates and exudates⁽⁵⁾. USG is useful in characterizing the nature of effusion. CT is of limited value in distinguishing transudate from exudates⁽⁶⁾ depending on attenuation coefficient. (Higher density indicates exudates)⁽⁷⁾.

Empyema

It is infected exudative pleural effusion when loculated it is lenticular shape making obtuse angle with chest wall.

"Split pleural sign": where the parietal and visceral pleura are split and show marked enhancement in empyema

CT helps to differentiate effusion from ascites by

- 1. Displaced crus sign⁽⁸⁾
- 2. Diaphragm sign (9).
- 3. Interface sign $^{(10)}$.
- 4. Bare area sign.

Focal Pleural Diseases

Includes pleural thickening and pleural plaques affecting most commonly parietal pleura. It is seen on USG as homogenous echogenic layer adjacent to chest wall and on CT as soft tissue opacity. Pleural plaques ossify if it is due to asbestosis.

Diffuse pleural diseases:

Includes fibrothorax, malignant mesothelioma and metastatic carcinoma and lymphoma.

Fibrothorax is characterized by pleural thickening more than 8 cm craniocaudally and 5cm laterally with thickness more than 3mm

Malignant mesothelioma, highly malignant locally aggressive tumour of pleura caused due to exposure to asbestos with an average latent period of 35 yrs ⁽¹¹⁾. CT appearance consists of pleural effusion with thickened irregular nodular pleura encasing the lung and extending into the pleural fissure. Occasionally only pleural effusion can be identified ^(12, 13).

Signs which indicate malignant pleural thickening are

1. Circumferential thickening

LIST OF PLEURAL PATHOLOGIES

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- 2. Nodularity
- 3. Parietal thickening >1cm
- 4. Involvement of mediastinal pleura.

Metastasis to pleura occurs from bronchogenic carcinoma, breast cancer, lymphoma, ovarian and gastric cancer. CT findings include pleural nodule, extensive pleural thickening with contrast enhancement.

Lymphoma shows characteristic CT appearance of pleural involvement, consists of localized broad based lymphomatous pleural plaques.



Case 1: axial CECT image showing enhancing nodular pleural mass with exudative right pleural effusion and liver metastases.



Case 2: axial CECT chest images of a patient with breast carcinoma in mediastinal and lung window showing bilateral pleural and mediastinal effusion and secondaries in lung.



Case 3: chest x-ray, USG and axial CECT chest of a patient with Bronchogenic carcinoma with metastatic lymphadenopathy and pleural nodules.

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Case 4: chest x-ray, USG, axial CECT chest of a patient with pleural lymphoma showing left exudative pleural effusion and enhancing nodular pleural based mass.



Case 5: X-ray chest and axial CT chest showing plaque like pleural calcifications.

OBSERVATIONS AND RESULTS



Table 1: Nature of pleural effusion:

Nature of effusion	No. Of patients	Percentage (%)
Transudate	28	28
Exudate	72	72
non malignant	34	47.20
malignant	38	52.80

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Bar diagram representing sonographic pattern and nature of pleural effusion



Table 2 showing sonographic pattern and nature of pleural effusions.

Effusions	Internal echogenecity				
	Anechoic n=58	Complex non- septated n=14	Complex septated n=24	Homogenously echogenic n=4	
Transudate	28 48.27%	0	0	0	
Exudate					
a. Non malignant	12 20.68%	8 57.14%	12 50%	3 75%	
b. Malignant	18 31.03%	6 42.85%	12 50%	1 25%	

Bar diagram showing nature of pleural effusion and associated findings



Table 3 showing thickene	d pleura and	l associated	findings.
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Nature of effusion	Thickened pleura Pleural nodule n=23 n=3		Parenchymal changes n=16	
Transudate	1	0	1	
Exudate				
a) Nonmalignant b) malignant	12 10	03	11 4	

Table 4 showing etiology of pleural effusion.

Transudate (n=28)	No.	Percentage
 a) Congestive heart failure b) Cirrhosis of liver c) Hypo albuminaemia d) others 	12 8 5 3	42 28.5 17.8 10.7
Exudate(n=72)		
 non-malignant(n=34) a) Tuberculosis b) Non tuberculous bacterial infections c) Empyema d) Pancreatitis 	14 8 8 4	46.6 23.5 23.5 11.7
 2. Malignant (n=38) a) Bronchogenic carcinoma b) Breast carcinoma c) Lymphoma d) Ovarian and gastric e) unknown 	13 9 4 1 1	34.2 23.6 10 2.6 2.6

Table 5 showing CT findings in 72 exudates and 28 transudates.

Group	Parietal pleural thickening	Extra pleural fat thickening	Visceral pleural thickening
Exudate n=72	44	24	15
Transudate n=28	1	1	1

Table 6 showing diffuse pleural disease n=38

Benign	18	47.4%
 Empyema Fibrothorax Asbestosis 	9 7 2	50% 38.8% 11.2%
Malignant	20	52.6%
 Metastasis Mesothelioma Lymphoma 	16 3 1	80% 15% 5%

Bar diagram showing characteristics of diffuse pleural diseases.



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Characteristic	Mesothelioma (3)	Metastasis (16)	Lymphoma (1)	Asbestosis (2)	Fibrothorax (7)	Empyema (9)
1. Nodularity	2	9	1	0	2	0
2. Rind	2	6	0	0	0	0
3. Thickness >1cm	2	3	1	0	1	0
4. Calcifications	0	1	0	2	4	1
5. Mediastinal pleural involvement	1	9	1	1	1	2
6. Unilateral involvement	0	10	1	0	4	8
7. Effusion	3	14	1	1	3	9
8. Hilar adenopathy	1	7	1	0	3	2

Table 7 showing characteristics of diffuse pleural disease.

DISCUSSION

The current study was undertaken to assess the evaluation of USG and CT in evaluation of pleural lesions. There have been few trials which have sought to determine the accuracy of USG and CT chest in these cases.

Age and sex incidence: In our study on 100 patients, 59 were males (59%) and 41 were females (41%).According to Aquino SL webb et al 1994 male (68.75%) and females (31.25%), Yang et al 1992, males were (59%) and females

were (41%). Between the age group of 2-80 yrs with mean age of 55 yrs. According to Yang et al 1992, mean age was 54 yrs, Aquino SL Webb et al 1994 it was 58 years.

Nature of pleural effusion

In our study transudate was 28% and exudates were 72% as compared to Aquino SL Webb et al 1994, transudate was 31.4% and exudates were 68.6%.

Sonographic patterns of pleural effusion

Pattern	Present study	Yang et al 1992
Anechoic	58%	53.75%
Complex non septated	14%	15.62%
Complex septated	24%	23.75%
Homogenous echogenic	4%	6.87%

Comparison table showing associated findings in pleural effusion

Findings	Present study	Yang et al 1992
Thickened Pleura	23%	23.75%
Pleural Nodule	3%	3.12%
Parenchymal changes	16%	16.87%



Comparison of studies evaluating CT characteristics of diffuse pleural disease

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The characteristic findings on CT in our study showed specificities of - nodularity (88%), pleural thickening >1cm(94.4%), Rind sign (100%) and mediastinal pleural involvement (88.8%), whereas according to Leung et al 1990 specificities were nodularity (94%), pleural thickening >1cm (94%), Rind sign (100%) and mediastinal pleural involvement (88%).

Comparison studies	s evaluating CT	characteristi	cs in malignant	t pleura l	l disease
	B	D 1	T 1 1 1 1 1		x 1

Percentage	Present study	Fredrick Abraham et al	Leung et al
Specificity (%)	83.33	83	83
Sensitivity (%)	70.00	72	72

CONCLUSION

ultrasonography The pattern of helps in differentiating the nature of effusion. In addition to the basic effusion patterns (anechoic, complex non septated, complex septated) a pleural effusion can be homogenously echogenic. Transudates are usually anechoic, whereas an anechoic effusion could be either a transudate or an exudate. Pleural effusion with complex septated, complex nonseptated or homogenously echogenic patterns always exudates. The most common are sonographic pattern in our study was anechoic which represented 58%.

CT scan revealed very small effusion. For detecting exudative effusion by CT, the sensitivity was 61.11% and specificity was 96.44%. The CT features most helpful in distinguishing malignant from benign pleural disease are pleural rind, nodular pleural thickening, pleural thickening greater than 1cm and mediastinal pleural involvement. Overall, the sensitivity was 70% and the specificity was 83.33% for detecting malignant pleural disease in our study.

Hence the role of ultrasound and CT are complimentary, giving high yield of positive results for pleural mass differentiation, useful for guided procedures like pleural biopsy and pleural drainage. Combined study not only useful for localization of lesion but also gives information about the extent of disease and characterizing the tissue density by analysis of attenuation coefficient.

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